

WASHINGTON

# SCIENCE TRENDS

HIGHLIGHTS

- \* Air Force Research Concepts
- \* Science Film Study
- \* Gamma Ray Standards
- \* NASA Research Highlights
- \* Research Checklist
- \* Publication Checklist

Vol. III No. 5

October 19, 1959

## Air Force Research Concept

Management concepts of the Air Force Materials programs are divided into three main categories, according to Lt. Gen. B. A. Schriever, Commander, Air Research and Development Command.

Typical current programs:

- \* Integrated Testing and Evaluation - In an accelerated search for new rocket nozzle materials, the Air Force has combined development with testing and evaluation. Potentially useful materials are fabricated into nozzles and fired in miniature rocket motors employing a variety of propellant combinations.

Materials which appear to be superior are then fabricated into full-scale nozzles and tested by a second contractor. The nozzles fired in both the miniature and full-scale facilities are examined metallurgically and evaluated by a third contractor, with the results transmitted to all propellant and rocket engine developers.

- \* Prototype Evaluation - The Air Force developed this approach to "fill the gap" between laboratory results and construction of full-scale components. Typical program is the search for available heat-resistant materials for hypersonic leading-edge applications for a so-called boost-glide vehicle.

In this program, emphasis is being placed on re-usable rather than expendable structures capable of operating in temperature ranges as high as 2500° to 3000° F., with ablation and cooling techniques excluded from consideration.

Four interrelated phases being pursued involve design, materials evaluation, fabrication and component testing. Now in development are design techniques for employment of brittle, heat-resistant materials. A small list has survived preliminary screening, including silicon carbide, graphites, and molybdenum alloys and several heat-resistant coatings. Those which survive laboratory tests will be fabricated into hypothetical leading edges and retested.

- \* The Calculated Risk - This approach to possible "technological breakthroughs" de-emphasizes application and product improvement of well-established commercial materials in favor of advanced materials and techniques. These include beryllium and the refractory metals, graphite, inorganic rubbers, composite structures, fine filaments and thermionic materials as well as new techniques such as electron beam melting, the use of extreme pressures and temperatures, and molecular engineering.

### New Gamma Ray Radioactivity Standards

National Bureau of Standards now has available for sale to qualified purchasers new gamma ray radioactivity standards for strontium-85, niobium-95 and mercury-203. Such standard samples are widely used in physics, chemistry, biology and medicine to control processes and to maintain the accuracy of equipment and apparatus.

Although most nuclides issued as samples are used as calibrated working standards for the same nuclide, strontium-85 is an exception. The Bureau points out that this particular nuclide emits gamma rays with an energy of 513 kev, which is almost identical to the energy of positron annihilation radiation. Strontium-85, with a half-life of 65 days, can therefore be used to calibrate instruments for positron emitter measurements.

(Samples obtainable at \$27 each from Radioactivity Section, National Bureau of Standards, Washington 25, D.C. Purchasers must have a current by-products material license on file at the Bureau.)

### Product-Process Evaluation

U.S. Department of Agriculture is organizing a new technical staff to evaluate market potential and industrial practicability of products or processes which might be developed through various Departmental research efforts.

The new Product and Process Evaluation Staff will be headed by Dr. John R. Matchett of the Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D.C.

### Rapid Amortization Program Ending

Statutory authority for the rapid amortization of defense facilities by the Office of Civil and Defense Mobilization ends Dec. 31, 1959. The program contributed greatly to the rapid expansion of defense industry during the Korean conflict.

At its height the program covered 229 categories of industry. In August 1957 the program was scaled down to limit certification to facilities to produce new or specialized defense items or components, to provide research, development or experimental facilities for the Department of Defense or the Atomic Energy Commission, or to provide primary processing facilities for uranium ore or concentrates. About 128 applications are now pending in these categories.

### Zirconium Ores

General Services Administration plans to sell on a sealed bid basis zirconium ores which are used in foundry sand castings and in the production of zirconium metal, ferroalloys and refractories. Bids close No. 27.

(Further information available from George K. Casto, Defense Materials Service, GSA, Washington 25, D.C.)

### Scientific Research Films

National Academy of Sciences will conduct a novel study of the use of film for recording scientific phenomena and for the communication of research results. Expectations are that the possibility of establishing adequate and feasible procedures for collecting, storing and disseminating data can be determined.

Study is not concerned with the use of film for the "popularization" of scientific knowledge. Rather, it will stress the use of the motion picture camera as a data-recording device in basic and applied research.

The initial study, to be limited to certain private research groups and university laboratories, may later include industrial and governmental establishments.

(For further information write Robert E. Green, Advisory Board on Education, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D.C.)

### Saline Water Conversion

A nuclear-powered saline water conversion plant at Point Loma, San Diego, Calif., will be jointly developed by the Atomic Energy Commission and the Department of the Interior, with a January 1962 completion date.

Commission will design, construct and operate a 40,000 thermal kilowatt experimental low-temperature process heat reactor of the pressurized water type, designed to produce saturated steam at pressures from 5 to 175 pounds per square inch. In addition to its water conversion application, the reactor will also be used to determine the economic and technical feasibility of process heat reactors for such purposes as the production of primary metals, glass and cement and petroleum, coal, chemical, food and paper products.

Water conversion plant, which can be operated independently, will incorporate advanced concepts of the so-called multistage flash distillation process.

### Flight Navigation System

All-weather operation of aircraft and helicopters without the assistance of ground-based helicopters and other present navigational aids is claimed by the Army Signal Corps.

A 120 pound radar navigation and flight instrument system (AN/APN-118) was developed for the Army by the Sperry Gyroscope Co. It features a nine-inch square map display which shows a pilot visually his aircraft's position and progress. System also features a "free gyro" for application at extreme altitudes and in polar regions where magnetic references become unreliable, as well as a movable tape which tells a pilot his speed and rate of climb. The system is being evaluated at the Army Aviation Center, Ft. Rucker, Ala.

## NASA Research Highlights

Here are some of the highlights of research programs outlined by the National Aeronautics and Space Administration this past week:

- \* Re-entry Physics - NASA intends to employ its "Scout" vehicle system to obtain missile re-entry data at the actual velocities of satellites and planetary vehicles. Instrumentation such as an ablation sensor will be used to measure the effectiveness of various re-entry materials.

Ground-based re-entry experiments, using ceramic-heated air jets, already indicate new and largely unexpected difficulties in re-entry. In laboratory tests, as an example, materials such as tungsten and molybdenum reacted vigorously with the oxygen in the airstream at temperatures far below their nominal melting points.

Emphasis, therefore, is now being placed on approaches such as the development of protective coatings. NASA scientists point out that in addition to heat resistance such coatings must be sufficiently elastic so that they do not fail under strain until after failure of the base metal. The materials also must not reduce the strength of the base metal. This field of research is said to be "only in its infancy."

Other studies are concerned with transpiration cooling systems in which a gaseous coolant is ejected through a porous leading edge into the boundary layer. The effect is to lower the heating ability of the hot boundary layer adjacent to the porous surface. A prime advantage of this system is improved effectiveness as the air temperature or flight speed increases. However, there is an associated decrease in overall system effectiveness due to the so-called plumbing weight presently required for transpiration cooling.

NASA researchers have also studied the heat-sink cooling methods as well as ablation systems. They point out that ablating materials are relatively effective at low speeds but also increase in effectiveness under high-speed conditions - therefore making them increasingly competitive with other proposed and actual systems.

- \* Hypervelocity Impacts - Satellite and space probe data indicate that continuous "bombardment" by interplanetary atoms and ions pose a newly-discovered obstacle to space flight. The microscopic particles, moving at nearly two million miles per hour, can erode the skin of a space vehicle through "sputtering." While structural strength is not likely to be disturbed, any resultant change in "skin" reflectivity is likely to create severe temperature imbalances.

Laboratory tests of this phenomenon were conducted by observing the erosion of a polished copper specimen placed in a particle accelerator, where deep pits were caused by nitrogen atoms.

- \* Space Vehicle Configurations - NASA studies indicate that relatively minor amounts of lift can effectively reduce acceleration forces in space vehicles. A number of winged research configurations are under scrutiny in wind-tunnel tests. One method which is said to appear "feasible" would have a winged glider re-enter the atmosphere in a steep nose-high position - as high as 90 degrees. This, according to studies, would reduce heating while permitting the vehicle to unfold wing panels to land as a conventional glider.



### Research Checklist

- ( ) Chromium Plating: A project at the Charleston Naval Shipyard has resulted in a new method of plating Stellite and other non-magnetic materials with chromium. The metals are first cleaned with acetone and are then etched in a special sulphuric solution in a lead-lined tank using reverse current. The metal is later placed in a chrome tank, where plating is started at the lowest possible current. Tests on 74 samples, including stainless steel, copper, monel and stellite have demonstrated satisfactory adhesion.

- ( ) Iron Corrosion: Studies by the National Bureau of Standards indicate that the crystallographic orientation of the metal surface determines the susceptibility of an iron specimen to corrosion pitting in distilled water. Similar results were recorded previously for copper and aluminum. The studies are expected to lead to better methods for combatting corrosion.

- ( ) Satellite Control Problems: National Aeronautics and Space Administration is studying the various torques which may disturb a satellite in orbit and thereby complicate control and guidance problems. Equations have been derived which aid in the study of orbital stability from the standpoint of gravity torque.

(Report available. 45 pages. Single copies free. Write NASA, Code BID, 1520 H Street, N.W., Washington 25, D.C. for Technical Note D-70)

- ( ) Solid Propellant Research: An improved method for the measurement of "creep" caused by aging in solid propellants has been developed for the Wright Air Development Center. Measurements are made continuously and automatically by means of a differential transformer combined with a strip-chart recorder. Stress relaxation can also be measured by automatically recording the output of a dynamometer consisting of a strain ring and a differential transformer.

(R&D by Chemical Engineering Section, Stanford Research Institute, Menlo Park, Calif.)

- ( ) Aircraft Landing Gear: A so-called "high flotation" landing gear system is being developed for the Army Transportation Corps by Fairchild Aircraft and Battelle Memorial Institute. A low-pressure tire is combined with a valve system that rapidly and automatically bleeds air from the tire upon landing on rough, unprepared fields. Pressure can be reduced rapidly from 17 to 2 pounds per square inch. Upon take-off the tire is fully deflated and folded into a helical bellow within the aircraft.

- ( ) Cellular Plastisols: Studies at the Army's Rock Island Arsenal have led to development of cellular plastisols as coating materials for metal handwheels to protect the hands of operators from high temperatures. Plastisol was selected because its many individual air cells act as thermal barriers and because of its ability to gel satisfactorily around a heated item.

### Publications Checklist

- ( ) Algae, the report of an eight-year study which concludes that fresh water algae may eventually supplement food and forage products and become a new source of vitamins, feed, fertilizer and other organic products. 100 pages. \$1. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C.)
- ( ) Ordnance Research, a synopsis of philosophy and operations prepared by the Office of Ordnance Research. A valuable guide to programs and organizations. 53 pages. Single copies free. (Write OOR, Box CM - Duke Station, Durham, N.C. for Synopsis -- OOR)
- ( ) Atomic Tests, testimony given in June 1959 and now released, by John A. McCone, Chairman, Atomic Energy Commission. Covers the Geneva negotiations on atomic test bans. 32 pages. Single copies free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D.C.)
- ( ) Iron Oxides, a report on a Government-Sponsored study of vacuum flotation tests of iron oxides using fatty and resin acids as collectors. 24 pages. Single copies free. (Write Publications-Distribution Section, U.S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa., for Report of Investigations No. 5498)
- ( ) Science and Astronautics, a report of activities by a Congressional committee active in these fields. 51 pages. Single copies free. (Write Committee on Science and Astronautics, George Washington Inn, Washington 25, D.C. for Report No. 32)
- ( ) Noise Control, a brief report which attempts to explain in non-technical terms why some sounds become "noise" and suggesting standards for noise control. 6 pages. 10 cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Pub. No. L 16.3:207)
- ( ) High-Speed Flight, the newly-published abstracts of unclassified papers presented at a 1957 conference on problems of high-speed flight sponsored by the Air Force, University of Florida and The Martin Co. Covers hypersonic and supersonic aerodynamics, heat transfer, proof of design, materials and similar matters. 210 pages. \$3.50. (Write OTS, U.S. Dept. of Commerce, Washington 25, D.C. for P.B. 151 538)
- ( ) Mathematics Instruction, brief circulars listing mathematics books for secondary school students and professional reference books on mathematics Instruction. Single copies free. (Write Publications Inquiry Unit, U.S. Office of Education, Washington 25, D.C. for Circulars No. 585 and 586)
- ( ) Data Processing, a report on general-purpose subroutines for a magnetic drum data processing machine equipped with floating decimal arithmetic, immediate access storage, and indexing accumulators. The package is said to be capable of calculating a number of transcendental and arithmetic functions common to most engineering problems. 46 pages. Single copies free. (Write NASA, CODE BID, 1520 H Street, N.W., Washington 25, D.C. for Technical Note D-68)

